

**State of California  
Air Resources Board**

**MANUFACTURERS' ADVISORY CORRESPONDENCE 2006-02**

- SUBJECT:** Policy Regarding the "Fast Refueling Capability" Criterion For 2003 and Subsequent Model-Year Type III Zero-Emission Vehicles (ZEV). In California Code of Regulations (CCR), Title 13, Section 1962(d)(5)(A) and information requested for Advanced Technology Demonstration Applications.
- APPLICABILITY:** Manufacturers of 2003 and subsequent model-year ZEVs placed in service in California or approved in a California Advanced Technology Demonstration Program.
- REFERENCES:** CCR, Title 13, Section 1962, and the incorporated "California Exhaust Emission Standards and Test Procedures for 2005 and Subsequent Model ZEVs, and 2001 and Subsequent Model Hybrid Electric Vehicles, in the Passenger Car, Light-Duty Truck and Medium-Duty Vehicle Classes," adopted August 5, 1999, as last amended December 19, 2003.

**FAST REFUELING CAPABILITY**

**BACKGROUND:**

In 2003, the Air Resources Board (ARB or Board) amended several portions of the California ZEV regulation. One of these modifications was to simplify the assignment of credits to ZEVs. Section 1962(d)(5)(A), "ZEV Tiers for Credit Calculations," identifies the criteria for a 2003 and subsequent model-year ZEV to qualify for the "Type III ZEV" tier:

- Urban Dynamometer Driving Schedule (UDDS) ZEV Range:  $\geq 100$  miles
- Fast Refueling Capability: "Must be capable of replacing 95 percent maximum rated energy capacity in  $\leq 10$  minutes"

Since the 2003 ZEV amendments were adopted, there have been several inquiries regarding the specific details on how the fast refueling capability requirement for Type III ZEVs will be applied. Further detail regarding fast refueling of 2003 and subsequent model-year ZEVs is not specified in either the ZEV regulation or the incorporated test procedures. Furthermore, ARB staff cannot yet make use of references to industry definitions, standards, or test procedures because these are still under development for one of the likely technology candidates for Type III ZEVs, the fuel cell vehicle (FCV). The fast refueling criterion is important because the distinction between Type II and Type III is crucial to manufacturers who wish to take advantage of the additional incentives ARB is providing for Type III ZEVs in model years 2003 through 2012.

Type III ZEVs serve as the key to many vehicle manufacturer's expected plans to pursue the ZEV Regulation Section 1962 (b)(2)(B) Alternative Requirement for Large Volume Manufacturers.

### **DISCUSSION: State of Present Technology and Standards for Type III ZEVs in the 2003 and Subsequent Model Years**

At the time of the 2003 ZEV regulation amendments, the state-of-the-art for hydrogen storage in developmental FCVs was the use of:

- 5,000 pounds per square inch (psi) or 35 megapascals (MPa) for compressed hydrogen storage
- liquid hydrogen
- metal hydride storage
- sodium boro-hydride systems.

The majority of hydrogen FCV prototypes made to date are equipped with compressed hydrogen storage. Since 2003, compressed hydrogen storage systems have become available at an alternative 10,000 psi (70 MPa) pressure rating in order to further improve the range of hydrogen vehicles. This increase in pressure results in a hydrogen vehicle range increase of approximately 67 percent for the same tank volume. At the time of the 2003 amendments, the feasibility of refilling 5,000 psi tanks in less than 10 minutes seemed certain, and ARB received very little comment regarding challenges involved in meeting the proposed Type III fast refueling criterion of 10 minutes.

Most demonstration vehicles outside of the manufacturer's test facilities currently refuel under conservative default or "non-communication" standards that were developed at the California Fuel Cell Partnership. Under some circumstances, these preliminary and conservative fill standards are expected to achieve less than 10 minute refueling times when used with 5,000 psi (35 MPa) vehicle storage tanks. Fast refueling is not yet achievable using 10,000 psi storage systems with these preliminary fill standards. The longer refueling times for these systems will eventually decrease as refueling standards and dispensing equipment technology mature and the industry settles on solutions to accelerate the refueling process. These improvements might eventually include "communication" type fills in which the vehicle dictates the optimal flow rate versus time to achieve the fastest possible fill for the tanks on that particular vehicle, or fills involving hydrogen chilled to sub-ambient temperature. In the meantime, there will likely be an interim period where many 10,000 psi hydrogen vehicles will not achieve sub-10 minute refueling with present-day dispensing equipment. ARB staff is confident that the refueling infrastructure improvements will eventually be implemented and that nearly all commercial compressed hydrogen vehicles will ultimately meet the sub-10 minute refueling requirement under every-day refueling conditions. Furthermore, ARB staff believes that most if not all existing FCVs with 10,000 psi hydrogen storage tanks are fully capable of sub-10 minute refueling when used with experimental refueling apparatus that is not yet available for public demonstration use.

ARB's intent when specifying the "95 percent" in the "95 percent maximum rated energy capacity in  $\leq$  10 minutes" requirement was to allow manufacturers an additional (5 percent) tolerance (pad). This 95 percent value was not specifically intended to allow for decreased fuel capacity due to fast fill (relative to slow fill) or for unusable fuel capacity inherent in all fuel systems. It was ARB's intent that the maximum rated energy capacity would have already been compensated for unusable fuel and fast-fill limitations.

**POLICY: Applying the "Fast Refueling Capability" Criterion for Type III ZEVs in the 2003 and Subsequent Model Years**

1. The "fast refueling capability" criterion for a 2003 and subsequent model-year Type III ZEV in CCR, Title 13, Section 1962(d)(5)(A), "ZEV Tiers for Credit Calculations," will be considered met for a particular ZEV if the manufacturer declares that this ZEV can be fast refueled at an "ideal" or prototype refueling or charging station and provides the documentation described below. ARB does not require that this fast refueling requirement must necessarily be met at any currently-existing public refueling or charging station.

ARB expects that the "ideal" or prototype refueling/charging station equipment will be fully described in either the certification or demonstration documentation for the vehicle, and that this description will include (but not necessarily be limited to):

- Tank or battery specifications
- Ambient and tank conditions prior to the qualifying fill/charge  
(At this time, ARB will not be specifying the environmental conditions under which this test refueling must occur)
- Plot or table of kilograms (kg) (or kilowatt-hour (kw-hr)) versus time for this "ideal" fill or charge
- A general description of the fill or charge type (strategy)

2. It is expected that the "maximum rated energy capacity" value that a manufacturer declares will be the same value used to determine vehicle range and that this "maximum rated energy capacity" value has already compensated for unusable fuel and fast-fill limitations. Since the requirement is that 95 percent of this capacity be delivered to the vehicle fuel system in 10 minutes or less and since Type III ZEVs must achieve a minimum 100 mile UDDS range, it is therefore equivalent to requiring a Type III ZEV to have the capability to accumulate at least 95 miles of UDDS range in 10 minutes or less.

Additionally, in the case of Type III Battery Electric Vehicles (BEV), ARB would not expect a manufacturer to restrict warranty coverage for customers that fast charge using manufacturer approved equipment.

## **ADVANCED TECHNOLOGY DEMONSTRATION PROGRAM**

### **BACKGROUND:**

A vehicle placed in a California advanced technology demonstration program may earn ZEV credits even if it is not “delivered for sale” in accordance with the ZEV regulation (Section 1962(g)(4)). Approval by the ARB’s Executive Officer is required for Advance Technology Demonstration Program credits. Generally, this credit is only available for advanced technology vehicles, such as fuel-cell powered vehicles that may or may not be registered with the Department of Motor Vehicles (DMV).

### **DISCUSSION:**

In order for the Executive Officer to evaluate advanced technology demonstration programs, staff is providing an attached “Data Needed” list.

## DATA NEEDED

Please provide the information listed below to the California Air Resources Board Executive Officer with a copy to the ZEV Bank Program Manager to apply for an Advanced Technology Demonstration Program.

### Project Description:

- general description
- goal
- specific objectives (e.g. durability tests, customer marketability)
- location (include state, city, and agency/organization)
- projected schedule

### Vehicle data:

- model
- year placed in program
- Vehicle Identification Number (VIN)

### Vehicle specifications:

- passenger car (PC) or light duty truck (LDT)
- curb weight - pounds (lbs)
- payload (lbs)
- city/highway range - miles (mi)
- estimate fuel economy or EPA fuel economy city/highway - miles per gallon (mpg)
- fuel type
- refueling time
- for Type III vehicles, fuel cell stack: type, peak output, manufacturer and estimated design lifetime
- fuel storage description; type (e.g. high pressure hydrogen storage tanks) and capacity (e.g. kilograms at a given pounds per square inch (kg @ psi)
- for BEVs and hybrids - fuel fired heater (yes/no)
- electric motor power output - kilowatts (kW)
- hybrid energy storage; type, capacity and peak power

For Type III vehicles, in addition to the information listed here, please see the previous section for fast refueling documentation.